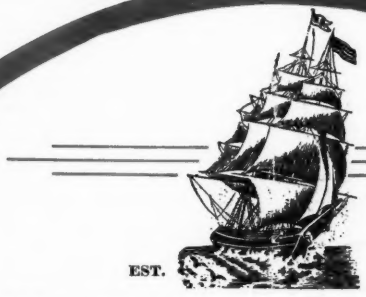
The American Fertilizer

JULY 6, 1940

No. 1



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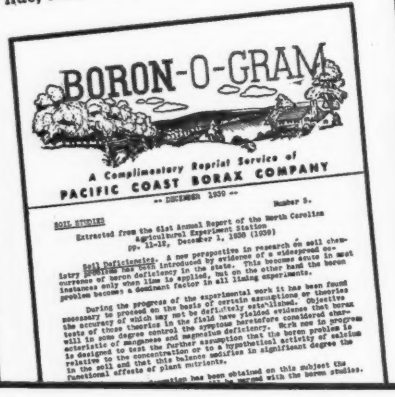
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-- DECEMBER 1930 -- Number 5.

SOIL STUDIES

Extracted from the 61st Annual Report of the North Carolina Agricultural Experiment Station pp. 11-12, December 1, 1930 (1930)

Soil Deficiencies. A new perspective in research on soil chemistry has been introduced by evidence of a widespread occurrence of boron deficiency in the state. This becomes acute in most instances only when lime is applied, but on the other hand the boron problem becomes a dominant factor in all liming experiments.

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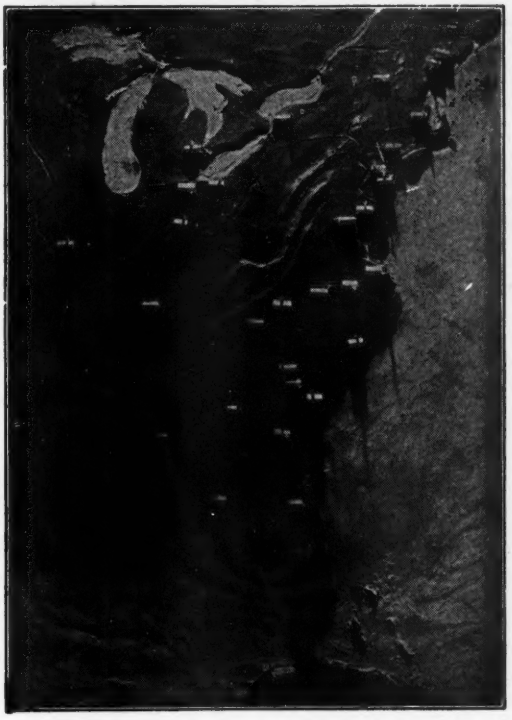

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See Page 23

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Vol. 93 JULY 6, 1940 No. 1

Possible Development of the Superphosphate Industry*

By SVEN NORDENGREN and HANS LEHRECKE

Landskrona, Sweden

LAST year and this will constitute landmarks in the history of the superphosphate industry, for a century has passed since Liebig suggested the treatment of bone meal with sulphuric acid in the production of a phosphatic fertilizer, and since superphosphate was manufactured for the first time on a technical scale in England by Lawes. During the last hundred years superphosphate has maintained its position as the principal phosphatic fertilizer, and it has resisted all attempts to displace it from this position of honor. It is little short of remarkable that the manufacture of calcium superphosphate continues to be undertaken in almost precisely the same manner as obtained a hundred years ago, although the mechanical devices have been improved.

The reason for this is not far to seek. Simplicity of operation, and the essential cheapness of the process, are the dominant considerations which have rendered the method of manufacture impregnable. To grind the raw materials —bones, coprolites, phosphorites and apatites— to subject such ground material to the action of sulphuric acid, allowing the mixture to solidify, and to disintegrate the resulting product, are unit processes of such simplicity as to admit easily of reproduction on a large scale.

The acid used in the decomposing process is the cheapest known mineral acid, and the raw phosphatic materials are available in large quantities in various parts of the world. By a curious coincidence, the concentration of sulphuric acid produced by the lead chamber process— the process which has maintained its importance and prestige for a longer period than any other—is found to be almost identical with that demanded for the manufacture of calcium superphosphate. Moreover, the primary raw materials—phosphorite and apatite—have revealed such a uniformity of chemical characteristics and physical attributes that constancy of technique has followed as a natural corollary.

On the occasion of the centenary of the superphosphate industry, the question might well be asked: is this established technique to continue in the future, without modifications, and is it in the interests of superphosphate manufacturers to continue to produce the same quality of material, or has our increasing knowledge suggested any changes of technique and application? Before these questions are answered, it will be well to study the present situation, and review our experience without prejudice. In this way only can a correct perspective be arrived at—one that is calculated to guide us aright in determining the steps to be taken to strengthen and fortify the future position of the superphosphate industry.

Competitors of Superphosphate

It is desirable, first of all, to make a careful study of phosphatic fertilizers, both present and future. The oldest competing phosphatic fertilizer, guano, has lost its earlier significance, on account of diminishing deposits and restrictions in the export of these deposits from the countries in which they arise. Meantime, basic slag has achieved importance as a phosphatic fertilizer. Its advantage over superphosphate lies in the fact that it is a by-product, and the cost of production depends on the extent to

* This paper was to have been read at the meeting of the International Superphosphate Manufacturers' Association at Hamburg on Sept. 13-15, 1939, but the outbreak of war led to the cancellation of the meeting. Reprinted from "The Chemical Age," March 9, 1940.

which steel is produced. This factor enables producers of basic slag to sell their product at a lower price than that of superphosphate.

Hitherto, basic slag has constituted the principal competitor of superphosphate. In several countries, however, other phosphatic fertilizers are marketed which, like basic slag, have a citric-acid-soluble, or even citrate-soluble, content of phosphoric acid. Among these may be mentioned the German "Rhenania-Phosphate," which is manufactured by sintering phosphate rock with soda and silica. Other products belonging to this group, as sold in France and Belgium, known as "Basi-" and "Supra-Phosphate," with citrate-soluble phosphoric acid, and the Russian "Thermo-Phosphate," are probably made in a similar manner. All these thermal processes are based in principle on the process of Professor Wilborgh, of Stockholm, which was developed and practiced about forty years ago.[1] Finally, mention should be made of the dicalcium phosphate produced mainly in Russia, France and Belgium, in combination with processes involving, as a by-product, hydrochloric acid.

Ammonium Phosphates

Apart from such fertilizers, in which the phosphoric acid is soluble in citric acid only, or in ammonium citrate solution, there is another group of fertilizers, having a water-soluble phosphoric acid content, but combined with other fertilizing compounds. Such fertilizers are mono- and di-ammonium phosphate and compound fertilizers containing these phosphates, such as the "Nitrophoska" of the I. G. Farbenindustrie, the corresponding products of Imperial Chemical Industries, Ltd., the "Ammophos" of the American Cyanamid Co., and others.

Coming now to the significance of these fertilizers, and their competitive possibilities, it can be said that basic slag has already reached a position where further competition can be expected only in relation to the increase in steel production. The importance of the other fertilizers thermally, with the help of alkali, containing their phosphoric acid in citrate-soluble form, will depend upon the price of the soda. The process is simple, and may well compete with superphosphate in this respect. The present soda ash prices make it rather improbable that the competition of such products will increase in the near future. If a process were evolved by which the production of soda could be made cheaper, the soda-containing phosphatic fertilizers would probably acquire some significance, as a result of which soda could be expected to take the present position of sulphuric acid in the phosphatic fertilizer industry. No signs of such reduction of soda prices have yet been observed.

The ammonium phosphates mentioned above might also become more important if it were possible to reduce the cost of producing phosphoric acid. On the other hand, the use of such fertilizers will be limited, as many countries will prefer to employ each fertilizer separately, and to regulate the proportions of the different fertilizers according to soil requirements.

In recent years considerable work has been undertaken, at various centres, to find a process of treating phosphate rock in a thermal way, without the addition of soda or other alkaline compounds. Up to now the methods used have not culminated in production on a commercial scale. It is conceivable, however, that the technical and economical problems involved will be solved, in which event superphosphate will be faced with a serious competitor. It therefore behoves the superphosphate industry to follow the development of these methods with the keenest attention.

The basis of the more important of these processes is the transformation of the phosphate rock or apatite, in the presence of silicic acid and water-vapor at high temperatures, to hydroxyl-apatite, and then to α-tricalcium-phosphate, a compound soluble in citric acid and citrate solution. This process was investigated on a laboratory scale about the same time by two German firms[2] and the Bureau of Chemistry and Soils, Washington.[3] Subsequently, details have been published of another process, by which the phosphate rock is decomposed by heating at sintering temperature with lime and silicic acid in given proportion to the phosphoric acid.[4] The effect of water-vapor is not mentioned in this publication, but there is no doubt

[1] I. G. Wiborgh, Brit. Pat. 2678/1896.

[2] (*a*) Bayerische Stickstoffwerke G.m.b.H., Berlin: German pat. appl. B. 159,157/V, 16 (11.1.33); German pat. appl. B. 169,097 (27.12.33; Austria); French pat. No. 766,874. (*b*) Kali-Chemie A.-G., Berlin: French pat. No. 775,457, with German priority from 29.8.33.

[3] D. S. Reynolds, K. D. Jacob and F. L. Rader, Jr.: Ind. Eng. Chem., **26**, 406-412 (1934): D. S. Reynolds, K. D. Jacob, H. L. Marshall and L. F. Rader, Jr.: Ind. Eng. Chem., **27**, 87-91 (1935); the same: Ind. Eng. Chem., **27**, 205-209 (1935).

[4] Kaiser Wilhelm Institut für Eisenforschung, Düsseldorf: German pat. appl. K. 137,390/V, 16, 26.3.1935. Danish pat. No. 52014. French pat. No. 800,726. Austrian pat. No. 150,505. Brit. appl. 5414/1936.

It is further interesting to note that the existence of a tricalcium phosphate soluble in citrate solution was found after investigations in the same institute (German pat. 662,913, 19.2.1932, by Dr. G. Trömel, Düsseldorf) before it was known that this form of tricalcium phosphate could be produced through the effect of water vapor on phosphate rock at high temperatures. See also F. Körber and G. Trömel, Report No. 254 of Stahlwerksausschuss des Vereins deutscher Eisenhüttenleute of 12.5.1933.

that its presence is necessary, to break down the molecule of the fluor-apatite.

The reason why these methods have not succeeded on a technical scale may perhaps depend on the velocity of the defluorization, which even if large quantities of water-vapor are present, is too low at the temperatures of sintering that have been used. Moreover, it may be difficult to obtain the necessary free surface when working on a larger scale, as contrasted with the laboratory. It would appear, therefore, that processes employing temperatures in excess of smeltingpoint, and involving less water-vapor, offer better prospects of success, even if the difficulty of furnace-lining may be greater.

In the United States a new type of phosphatic fertilizer—calcium metaphosphate[5]—has been produced. Phosphoric acid anhydride, produced thermally, reacts on phosphate rock, forming the said compound. How far this product can be manufactured practically and economically on a large scale it is impossible to say at present. No one has so far succeeded, under normal economic conditions, in producing phosphoric acid for fertilizers so cheaply, by a thermal process, that it can compete with the wet process. It is true that phosphoric acid is being produced by heat treatment for fertilizing purposes, but then the acid is used to fix ammonia, and it seems that the ammonia also covers part of the cost of production of this phosphoric acid. The fertilizing value of calcium metaphosphate, as contrasted with superphosphate, has yet to be determined, although it has proved satisfactory in the trials already conducted.[6]

The Quality of Superphosphate

Before any comparison with other phosphatic fertilizers is made, the quality of superphosphate should be studied from physical, chemical and agricultural points of view. As mentioned already, the nature of superphosphate and its agricultural effect have remained practically unaltered during the last hundred years. Certainly, the quality has been improved. The relationship between the quantities of phosphate rock and sulphuric acid, and the strength and temperature of the latter, have been regulated in such a way that a product of better physical properties, with a small amount of free phosphoric acid, can be manufactured. The moisture content of the product has been reduced from 15-16 per cent to as low as about 4 per cent by the employment of strong sulphuric acid, and the adoption of means of drying. If comparatively strong sulphuric acid is used, a product with 8 to 10 per cent of moisture can be manufactured without the necessity for drying. Pulverizers have been installed, with a view to producing a material of fine consistency, and the larger granules are removed by sieving.

Despite all these improvements, it must be admitted that a further improvement of the product is desirable. Although it is pulverized and sieved, the difference in particle size is considerable, and its plasticity and thixotropic property render distribution by spreading machines difficult. When superphosphate is stored in bulk, solidification, or "caking," cannot be avoided, and when the material is stored in bags these are destroyed after a time, because even a seasoned product contains a certain amount of free phosphoric acid. Bagging is therefore usually undertaken at the time of sale, which results in an accumulation of work at that time. If a phosphate rock with a comparatively high degree of iron and alumina is treated, the water-solubility will decrease after a certain period of storage, as indeed, under certain conditions, will the citrate-solubility. These disadvantages of superphosphate cannot be ignored.

It has, moreover, been asserted that one of the merits of superphosphate is the water-solubility of the phosphoric acid, and this attribute was said to give superphosphate an advantage over other phosphatic fertilizers. That a critical examination of this view should be made becomes increasingly important.

It has long been accepted that the water-soluble phosphoric acid of calcium superphosphate reacts on the soil with great rapidity. Heavy and acid soils react in this respect more rapidly than light and alkaline soils. It has been found that if superphosphate is spread on the surface of the soil, without being forked in, the phosphoric acid will penetrate only 1-1½ inches into the soil.[7] The cause of this fixation is the formation of water-insoluble compounds between the free phosphoric acid or the monocalcium phosphate and basic matter in the soil, such as iron, alumina, lime, etc. Further

[5] H. A. Curtis, U. S. pat. 2,113,574; H. A. Curtis, R. L. Copson, A. J. Abrams: Chem. Met. Eng., *44*, 140-142 (1937).

[6] J. Weissflog and H. Mengdehl: Zeitschrift f. wissensch. Biologie, *19*, Abtlg. E der Planta, Archiv f. wiss. Botanik, 242-270 (1933); Wm. H. Ross and K. D. Jacob: J. Ass. Off. Agr. Chem., *20*, 231-249 (1937); C. Krügel und C. Dreyspring: Superphosphate, *10*, 141-148 and 161-165 (1935). Also see W. H. MacIntire, L. J. Harding, F. D. Oldham: Ind. Eng. Chem., *29*, 224-234 (1937).

[7] See among others: Roemer, Superphosphate, *3*, 125 (1930); O. Franck, Meddelande nr. 483 fran Centralanstalten för försöksväsendet pa jordbruksomradet, Stockholm, 1937, with an English summary; G. Torstensson, Tidskrift för Lantmän, Helsingfors, *19*, 219-226 (1937); B. E. Beater, Soil Science, *46*, 453-466 (1938).

(Continued on page 24)

PRICE ON DOMESTIC NITRATE OF SODA UNCHANGED

Despite greatly changed conditions, and increased demand for nitrogen products, The Barrett Company announces a price of $27.00 per ton in bulk, f.o.b. cars U. S. Atlantic and Gulf ports, for Arcadian, the American nitrate of soda, for fertilizer year beginning July 1st. This represents no change from the price for Arcadian current in the fertilizer year just closing.

POTASH APPOINTS E. DECK NORTHWEST REPRESENTATIVE

The American Potash Institute, Inc., Washington, D. C., is announcing the appointment ofof Errett Deck as its Northwest Representative. In this capacity, Mr. Deck will supervise the Institute's agricultural educational program in the States of Washington, Oregon, and Idaho. He replaces Clay A. Whybark who resigned to take a position as agronomist with Hunt Bros. Canning Company.

After attending Whitman College three years, Mr. Deck transferred to Washington State College where he graduated in 1938, majoring in chemistry. Subsequently for two years he has been engaged in agricultural research as Potash Fellow at Washington State College while taking graduate work leading to the M.S.A. degree to be conferred in June.

With headquarters in Puyallup, Wash., Mr. Deck will work in close cooperation with experiment station officials, county agents, vocational teachers, canning companies, and the fertilizer trade. In these projects he will keep contact with growers, helping them with problems of soil fertility and plant nutrition.

MAY SULPHATE OF AMMONIA PRODUCTION INCREASES

The figures issued by the U. S. Bureau of Mines show that during May, 57,697 tons of by-product sulphate of ammonia were produced, an increase of 5.7 per cent over April, which showed 54,570 tons, and an increase of 75 per cent over May, 1939, when the output was 33,065 tons. For the first five months of 1940, production totaled 282,193 tons compared to 206,905 tons during the same portion of 1939.

For ammonia liquor, the report shows 2,209 tons (NH_3 content) during May, 1940; 2,164 tons during April, 1940; 1,511 tons during May, 1939. Accumulated totals for the January-May period were 11,295 tons in 1940 and 9,063 tons in 1939.

M. H. Lockwood, Springfield, Mass.

George W. Gage, Anderson, S. C.

Elected to the Board of Directors, National Fertilizer Association.

Some Problems Involved in Raising Farm Income

By J. W. TIDMORE

Head, Department of Agronomy and Soils, Alabama Agricultural Experiment Station, Auburn, Alabama.

(Continued from the issue of June 22, 1940)

"According to the 1935 census, there were 92,000 acres planted to corn in DeKalb County in 1934. There were 47,000 acres of cotton, 20,000 acres of hay, 15.000 acres of idle and fallow land, and 14,000 acres of plowable pasture.

"Under the AAA program for 1939 the cotton acreage permitted was 46,265. The total acreage of other soil-depleting crops allotted without penalty amounted to 110,147 acres. It is assumed in developing this program that the 92,000 acres of corn might be planted without incurring a penalty of any kind.

"It is proposed to add 32 pounds of nitrogen to each of the 92,000 acres of corn. This is in addition to the usual fertilizer applied by the farmer. This will take 9,200 tons of nitrate, which at $35 will cost $322,000. If a good cover crop of vetch or crimson clover is turned under, this extra nitrate will not be needed.

"This program should result in an increase of 1,840,000 bushels of corn in the county according to results obtained in three different experiments over an 11-year period at the Sand Mountain Station.

"This extra corn will cost 19 cents per bushel for fertilizer and interest charges, allowing $35 per ton for nitrate and for 8 per cent interest on the cost of the nitrate for nine months.

"The extra cost will support 12,690 brood sows and their 10 pigs each year. There will need to be supplied 150 pounds of supplement for each sow, 100 pounds of supplement for each 225-pound hog, and 145 bushels of corn for each sow and her 10 pigs. The brood sows will take 952 tons of supplement at $44 per ton or a total of $41,888. The 10 pigs from sows will take 6,345 tons of supplement at a cost of $279,180. Interest on the nitrate fertilizer and on the supplement will amount to $38,584.

"During the year the brood sows should produce 126,000 pigs. These, with the brood sows, should consume all of the supplement and the extra corn produced. The gross weight of the hogs produced for sale should be 28,552,500 pounds. At six cents per pound, the gross sale of fat hogs should amount to $1,713,150.

"In order to produce these hogs, the cash outlay for nitrate, for supplement, and for interest charges amounts to $681,652. If this is deducted from the gross sales, there is net balance of $1,031,498 for the simple operation of increasing the yield of corn on the acreage already planted in the county and feeding this surplus of corn to hogs with the right kind of supplement.

"On the basis of the average farm in the territory, the surplus corn will support about two sows. On each farm there would be planted 14 acres of corn which should make 280 extra bushels of corn with the treatment given above. The cost of nitrate and supplement and interest per farm would be $103. Hog sales from this farm would be $219.

"When hogs are produced on a corn basis, only a small amount of pasture is needed. Cost of fencing, fertilizing, and planting a three-acre pasture would be about $85.

"A two-horse farmer would need to be financed for the hog program to the extent of $51 for fertilizer for corn, $52 for supplement, $85 for pasture fence, seed and fertilizer, and $30 for two bred gilts or a total of $218. Hog sales the first season should amount to $219 or would almost exactly take care of his expenses for the first year. After the first year, the farmer would not have to buy brood stock, and the expense for pasture fence, seed, and fertilizer for the pasture should not exceed 15 per cent of the original cost of establishing the pasture, or an annual charge of $12.75. Net sales from hogs during the second year, therefore, should amount to $103.25 per farm.

"How does this source of income compare with the cash income from cotton in DeKalb County? In 1938, the county produced 30,801 bales of cotton at nine cents, worth $1,386,000, and cotton seed was worth $25 per ton $308,-000, or $1,694,000 for lint and seed. But there was a ginning cost of $92,403 and a fertilizer

bill (1938) of $397,000 to be paid from the cotton crop—this leaves $1,204,597 net income from cotton.

"This income from cotton is only $173,100 more than the potential income from hogs described above. In other words, the farmers of DeKalb County could still produce the cotton that they are now producing and add the hog program. Then their income would be $2,236,095 from cotton and hogs instead of $1,204,597 from cotton.

"The only financial difficulties involved is for these farmers to be financed to the extent of $218 each per starting year more than they are already being financed.

Peanuts as the Basis for Hog Production

"Work at the Wiregrass Station has shown that a crop of peanuts hogged off has about the same soil-building value as a good crop of vetch or Austrian peas turned under. Very good corn has been produced after grazed peanuts without fertilizer to the corn. It is possible to materially increase farm incomes in the peanut area by grazing peanuts instead of harvesting and selling them. The following discussion is based on results obtained on good land at the Wiregrass Station and the Brewton and Monroeville Fields. It is claimed that these results indicate a goal toward which agricultural workers and farmers may direct their efforts.

"At the Wiregrass Station, average yields of 1663 pounds of cotton, 2271 pounds of peanuts, and 37.9 bushels of corn have been made when these crops were grown in rotation. The cotton received 600 pounds of 6-8-4, but the peanuts and corn were not fertilized. Hogs grazed the peanuts, which were followed by corn. To give you an idea of the kind of land, this land produced 14.6 bushels of corn without fertilizer or cropping system to improve the soil.

"Applying these results to Monroe County for example as to the potential possibilities, this county was chosen because it is a typical county in the possible peanut area and the farmers of this county sell little besides cotton. The results, however, are applicable over most of the peanut area.

"The 1938 cotton crop, at nine cents for lint and $25 per ton for seed, was worth $1,281,500. The fertilizer bill was $248,640 and the ginning bill was $69,000. Subtracting these bills from the gross sales of cotton and seed, a net value of $962,960 is left for the cotton crop.

"The cotton allotment for the county in 1939 was 39,238 acres, and according to the census, there is available enough crop land in the county to plant 35,000 acres of peanuts and 35,000 acres of corn. Since at the beginning of such a program there would not be available enough grazed peanut land on which to plant 35,000 acres of corn, 3,500 tons of extra nitrate fertilizer would be needed for corn. At $35 per ton, this would cost $122,500. This should produce 400,000 bushels of corn more than is usually made in the county. After the first year corn would not need nitrate fertilizer since it would follow hogged peanuts.

"It is assumed that a yield of 1,400 pounds of peanuts would be made. This yield on 35,000 acres should produce $840,000 worth of hogs at six cents per pound. In this hog program 7,000 acres of soybeans would be needed for temporary grazing during July and August. These beans should be fertilized with 400 pounds of basic slag or 200 pounds of superphosphate per acre. This fertilizer for the beans would cost $13,000.

"A pasture is an essential part of the farm program if livestock are to be produced economically. For the county, about 16,000 acres of pasture would be required. Slag or phosphate and lime for this much pasture would cost $144,000, seed would cost $48,000, and fence $240 000. The total cost for establishing the pasture would be $432,000 or about $27 per acre. One-third of the increased corn crop would be fed to hogs; and since this must be produced with nitrate the first year, one-third of the nitrate cost ($40,900) should be charged to the pasture and temporary grazing crops, or a total of $485,900 the first year. Increased hog production from peanuts would amount to $840,000; and from corn, temporary, and permanent pasture an additional $560,000, or a total gross sale of hogs of $1,400,000.

"Against this, then, is a charge of $485,000 for pasture, nitrate, etc. The net for hogs would be $915,000 or nearly as much as the net from cotton (lint and seed). If these results are placed on the average farm basis, there would be an increased income of about $150 the first year and about $330 annually thereafter. The reason for the larger returns after the first year is that there would be less charges for pasture and nitrate and fertility of the land will increase so that larger yields will be obtained.

"This cash income from the sale of hogs would be almost all net cash, or return to the farmer for his labor since there would be practically no cash outlay for making the peanut crops.

"It is not claimed that all farm land in Monroe County can be put under such a program

immediately. However, it is claimed that the program is so simple and practical that much of the better land is immediately adapted to such a program, and that eventually all of it can be farmed under the system outlined. This program is applicable to most of the southern half of Alabama and to other southern States where peanuts fit into the program."

Cattle Production

No extended discussion or examples will be given under this topic.

In the production of cattle for milk or beef, again the most important consideration is an abundance of good feed produced cheaply enough to meet the competition and give a profit. Until a few years ago, there were practically no improved pastures in Alabama. At present, there are enough data on the subject of pasture production to show that good pastures can be produced in most sections of Alabama and I am sure that this is true for other Southern States. Good pastures are essential because they supply feed at the lowest possible cost for a good portion of the year.

In order to establish a pasture, the initial cost is high—$10 to $15 per acre for fertilizer, lime, and seed if a good pasture is to be expected from the start. Most of the farmers will consider you non-practical, a book farmer, and even crazy to talk to them about spending $10 or $15 per acre for a pasture; whereas, the same farmers will spend this amount annually on each acre of cotton when the cotton is being produced at a loss. After the initial cost, the pasture will get better from year to year with proper treatment without spending much more money on it. One could begin with a small acreage if he is short of cash—the point is to start.

Farmers have started in the cattle business, considering that pasture improvement is an index. During the past three or four years, about 50,000 or 60,000 acres of good pastures have been established in Alabama. This is hardly a "drop in the bucket" but it is a beginning.

Why Are the Recommendations Not Put Into Practice?

Many recommendations as to procedures or practices for various farm programs have been made by a number of people for a long time. We have made some today. If most or many of these recommendations are one half as good as we claim, why are they not put into practice? I make no claim to be able to answer this question to your entire satisfaction. In my opinion, a few of the reasons are as follows:

1. Lack of cash or good credit facilities with which to do many of the things recommended.

2. Recommendations necessarily are based on the average of a period of years. All businesses are based on averages. The farmer (the man who is doing the work—273,000 of them) usually does not base his operations on a five- or ten-year period or on a lifetime, but on one year at a time.

3. The present tenant system is not adapted to diversified farming. It may become adapted but at present it does not fit into the scheme. No one can say what a fair proportion of hogs, cattle, or milk produced on a farm by the tenant should be. This must be worked out after a considerable amount of experience.

Twenty per cent of the landowners in Alabama own 70 per cent of the land. This means that approximately two-thirds of the farmers are tenants. These tenants have little or no cash equity in their business of farming and are depending 100 per cent on the landowner for their living during the year. If the tenant makes a crop and gets a reasonable price, he can pay his debt; if he does not make enough to pay his debts, nothing is lost as far as the tenant is concerned. What about the landowner? In the past, before the depression, he has been getting a fair return on his investment. How? For example, the landowner owned a farm in which he had $3,000 invested and he was perfectly satisfied with $250 rent or enough of the crop to bring $250; then he would finance the tenant's operations to the extent of about $250. This was a good return on his investment since a $3,000 farm usually could easily produce $500 worth of cotton. All of this time the farm was getting poorer and more and more eroded. Then rather suddenly there was little demand for cotton and his acreage was reduced more than 50 per cent. The acreage reduction did no harm because the enormous amount of cotton could not have been sold for a decent price. Now the $3,000 farm will not produce $500 worth of cotton ($250 for rent and $250 for tenant's maintenance), and the landowner finds himself worried.

4. Too much has been left to the man doing the plowing. The man who is furnishing the money for the farming operations must know what the recommendations are or figure out some of his own, be sold on their merits, and see that they are carried out on the land that he is financing. In every county there are six or twelve men to finance the agriculture of the county, and these men can have more influence on the farm program than all of the other farmers combined.

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PIONEER JOURNAL OF THE FERTILIZER INDUSTRY

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Principal Articles in This Issue

PAGE

POSSIBLE DEVELOPMENT OF THE SUPERPHOSPHATE INDUSTRY 5

SOME PROBLEMS INVOLVED IN RAISING FARM INCOME 9

Brand Outlines Fertilizer Situation for National Defense 12

Rotary Cooler Developed for Ammoniated Fertilizers 14

FERTILIZER MATERIALS MARKET:

New York 15
Baltimore 17
Atlanta 18
Chicago 20
Wilmington 20
Philadelphia 20
Tennessee Phosphate 22

Brand Outlines Fertilizer Situation for National Defense

In answer to an inquiry from Chester Davis, of the Advisory Commission to the Council of National Defense, Charles J. Brand, Executive Secretary and Treasurer of the National Fertilizer Association, has prepared a brief statement which presents the advantageous situation of the fertilizer industry and its ability to meet any demands of American agriculture which the defense program may present. Mr. Brand's reply to Mr. Davis is as follows:

June 21, 1940.

HON. CHESTER C. DAVIS,
National Defense Commission,
Federal Reserve Building,
Washington, D. C.

Dear Mr. Davis:

In time of national emergency the commercial fertilizer industry of the United States can be depended upon to bend every effort to fulfill its part in meeting the common need. The officers and personnel of the more than 800 companies engaged in the industry, and the staff of this Association, will do their part to put into successful operation any emergency task they may be called upon to perform.

Fortunately for American agriculture, this industry is in a position to furnish all of the chemical plant food which might be needed. As I told Mr. Tapp in our telephone conversation yesterday in reply to your inquiry, there is no likely shortage of commercial fertilizer. Even if conditions during the next few years should make necessary an increase in crop production, with a consequent increase in the demand for fertilizer, the industry could still take care of every demand which might be made upon it.

The situation which now confronts us in regard to supplies of commercial fertilizer, both actual and potential, is quite different from that which existed at the time of the First World War. At that time we were dependent on European sources for practically our entire supply of potash. Chilean nitrate of soda was a principal source of chemical nitrogen, and since large quantities were required for Allied war use we experienced difficulty in getting sufficient amounts for the needs of agriculture. We also encountered trouble in obtaining an adequate supply of sulphuric acid for superphosphate production.

Developments since that time have removed

all possibilities of shortages of any of the three classes of materials.

Potash Resources

As to potash, the three domestic companies now in operation and a fourth company which will soon be in production can furnish all of the potash needed. The only possible shortage is in sulphate of potash, which is necessary for tobacco fertilizer and in the past has been used in fertilizer for other crops in certain areas. It now seems likely that there will be an adequate supply next season for tobacco and agronomists generally agree that other forms of potash can be used in place of sulphate for all crops other than tobacco without serious handicap. If the announced plans of the company now getting into operation materialize, it will be able to produce all of the sulphate of potash that will possibly be needed in this country. It thus appears that we shall never again be dependent on foreign sources for our potash.

Nitrogen Resources

As to nitrogen, our productive capacity is sufficiently large so that we are not faced with a shortage either for fertilizer use or for munitions or other purposes. By-product nitrogen in the form of ammonium sulphate takes care of a substantial part of the demand and since production fluctuates with steel mill operations it is likely to remain at a high level for some time to come. The two large and several smaller nitrogen fixation plants located in this country can greatly expand their output, never having been operated at capacity. Production at the cyanamid plant located at Niagara Falls, Canada, has been largely used in the United States and unless commandeered by the Canadian Government will likely continue to come here. In the past we have imported more than a half million tons of Chilean nitrate of soda annually. It is now difficult to see any contingency which might result in that source of supply being cut off. If such a condition should arise at some future time, however, our other sources could take care of the demand. Synthetic nitrate of soda has been produced in this country for a number of years and could take care of our need for nitrate in case of emergency.

Phosphate Resources

As to phosphates, our American reserves of phosphate rock are of course sufficient to take care of our needs for thousands of years. The only problem involved is that of processing to make the phosphoric acid available as plant food. We have used in the past about 4,000,000 tons of superphosphate a year, basis of 16 per cent phosphoric acid. With present plant and equipment facilities the 200 superphosphate plants can produce well over 10,000,000 tons of superphosphate annually. Obviously there is no question of shortage of plant capacity. During the First World War a shortage of sulphuric acid developed as a result of the large quantities needed for the production of nitric acid for munitions. As a result of changes since that time in manufacturing processes, sulphuric acid is no longer needed for that purpose. Nitric acid for munitions manufacture is now made by the oxidation of synthetically produced ammonia, and sulphuric acid is not necessary in this process. This leaves the industry's production of sulphuric acid available for superphosphate manufacture. The fertilizer industry, with its present facilities, could easily care for double the present consumption of phosphate.

As to the minor plant food elements, including magnesium, we are in a position to produce domestically all that we might need. There is a possible exception in the case of manganese, which is needed in small quantities in restricted areas, and which we now import from South America. We understand, however, that domestic sources are being developed.

As to mixed fertilizers, present capacity is double the maximum consumption in any past year so there is no possible shortage in that regard.

Prices Stable

As to fertilizer prices, the adequate supplies of the basic materials will prevent the sharp increases which resulted in 1914-1918 from the shortages then existing. Any increases in labor and transportation costs and taxes might be reflected later in fertilizer prices but these increases would probably be of very moderate extent. The severe competition existing among the 800 companies and the excess capacity act as guarantees against unwarranted price increases.

Farmers of America can be assured that in the next year, and in the years to follow, they can obtain all the fertilizer they might need at reasonable prices.

Again offering you the cooperation of the fertilizer industry in every way possible, I remain,

Very truly yours,

CHARLES J. BRAND,
Executive Secretary
and Treasurer.

ROTARY COOLER DEVELOPED FOR AMMONIATED FERTILIZERS

The research staff of E. I. duPont de Nemours and Company recently completed experimental work which resulted in the development of a small, low-cost cooler that is entirely practicable for cooling ammoniated mixtures.

It was discovered that a large portion of the heat was removed almost instantly by the evaporation of moisture from the hot ammoniated fertilizer. This cooling effect of evaporating moisture is easily demonstrated by wetting one's finger and holding it in front of a fan.

In ammoniated fertilizers around 150° F., between 0.5 and 1.0 per cent moisture can be evaporated. This of itself drops the temperature of the goods 20 to 30 degrees. The air used to carry away this moisture also can remove about the same amount of heat by its own capacity, resulting in a total drop of 40 to 60 degrees. This combined effect and the speed with which the evaporation occurs have reduced the air volume required and have resulted in equipment sizes approximately one-third those indicated by typical drier design calculations. Such a small but efficient cooler consists of three main parts: a cylindrical shell, a fan, and a dust collector, which can be assembled by the fertilizer manufacturer and fitted into his existing plant operations at a comparatively low cost.

General plans and essential design data for the construction of such a cooler have been prepared in folder form and will be sent upon request to the Ammonia Department of the duPont Company, Wilmington, Delaware. This folder points out that the removal of heat substantially reduces reversion of phosphoric acid, allows the manufacturer to use more ammonia, improves the condition or "feel" of the goods, and reduces caking in storage.

"The reduction in pile set should result in appreciable labor savings when digging down storage piles," it concludes. "It is also believed that additional caking reduction can be obtained by the increased degree of ammoniation which is made possible with cooling."

NO INCREASE IN NITROGEN SOLUTION PRICES

The Barrett Company has announced that the current prices for Barrett standard nitrogen solutions will be continued without change for the new fertilizer year, commencing July 1st.

The market demand for these comparatively new products developed by the Barrett Company is expected to increase. The price at present is $1.2158 per unit of nitrogen.

NEW CALIFORNIA FERTILIZER COMPANY FORMED

Associated Chemicals, a new fertilizer manufacturing company, has been started at Salinas, California, with a branch unit at San Carlos, California. The personnel includes J. Wilkes Jones, W. B. Dickens and J. C. Cardoza, all of whom were formerly engaged in fertilizer manufacture in San Francisco. The new company is operating a Stedman mixing and bagging plant, with supplemental crushing, screening and bagging units.

PIONEER POTASH COMPANY POSTPONES PRICE LIST

The Pioneer Potash Company has announced that, on account of the European war, they are not in position to offer potash salts for shipment. They are therefore postponing the issuing of the usual price list until such time as shipments can be arranged.

BRADLEY & BAKER

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FERTILIZER MATERIALS MARKET

NEW YORK

Announcement of Prices on Chemical Fertilizers Encourages Buying for Coming Season. Organic Materials Continue Sluggish.

Exclusive Correspondence to "The American Fertilizer."

NEW YORK, July 2, 1940.

Interest in the fertilizer materials market during the past two weeks has increased with the announcement of new seasonal prices on nitrate of soda and sulphate of ammonia. Both domestic and foreign suppliers of the former material have announced that there will be no change in the bulk price of nitrate throughout the coming fertilizer year and bagged material also remains the same but is only quoted for delivery as far as July 1st. Suppliers of sulphate of ammonia have announced that they will maintain the old port price through December with an increase of $1.00 per ton December forward. Sulphate of ammonia will also be sold during the new season on an f.o.b. producing point basis, thus giving buyers a choice of basing points.

With new prices on most primary materials now in effect, fertilizer manufacturers are making sizable bookings to cover their requirements, and chemical fertilizers are generally in strong demand. With few exceptions, organics continue to be sluggish, the demand is small, and almost all materials in this market show a decline in price.

Nitrate of Soda

Schedule of $27.00 per ton in bulk, f.o.b. ports, now in effect for the entire season 1940-41. Bagged material quoted for July only at the unchanged price of $29.00 per ton in 100-lb. bags and $28.30 per ton in 200-lb. bags, port basis. No shortage of stock for the coming year is anticipated.

Sulphate of Ammonia

New prices now prevail at $28.00 per ton in bulk, f.o.b. usual Atlantic and Gulf ports, and/or $27.00 per ton in bulk, f.o.b. inland producing points. Heavy bookings have been made for new season deliveries.

Superphosphate

Ordinarily superphosphate is firm at 52½ cents per unit in bulk, New York basis, and it is in fair demand. Triple superphosphate is very strong and some producers are reported to be sold up for the next three months period.

Potash

Bookings for the new season continue to be normally heavy. New price on muriate prevails at 53½ cents per unit K_2O in bulk, ex vessel ports, and/or 42.3 cents per unit K_2O in bulk, f.o. b. Carlsbad.

Dried Blood

There is practically no demand at the present time for this material. Domestic productions are quoted at $2.35 per unit ammonia ($2.85½ per unit N), New York, and South American blood is offered at $2.45 per unit ammonia ($2.98 per unit N) c.i.f. ports.

Tankage

With no buying interest to speak of, domestic material is offered at $2.00 ($2.43 per unit N) and 10 cents for the 8/9 per cent and 11/12 per cent grades. South American low test tankage is quoted at $2.75 ($3.34½ per unit N) and 10 cents c.i.f.

Nitrogenous Material

Following rather substantial seasonal bookings, this market is very dull. The nominal value of domestic material is $1.50 per unit ammonia ($1.82½ per unit N) at all producing points except Norfolk.

Fish Scrap

Menhaden scrap has weakened somewhat, the last business having been done at $3.40 ($4.13½ per unit N). Buyers' ideas are now in excess at $3.35 ($4.07 per unit N) and 10 cents. In view of early sales amounting to approximately 8,000 tons, producers are now in a comfortable position and are not forced to press for bookings, especially since the catch has been exceedingly light.

KNOW - - - -

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the number of pounds of raw material for a desired per cent. of plant food in a ton of mixed goods—or find what per cent. of a certain plant food in a ton of fertilizer produced by a specific quantity of raw materials.

No mathematical calculations are necessary. You can find the figures in a few seconds with the aid of

Adams' Improved Pocket Formula Rule

A Great Convenience for the Manufacturer of High Analysis Goods

To make clearer its use, answers to such problems as the following can be quickly obtained:

How much sulphate of ammonia, containing 20 per cent. of nitrogen, would be needed to give 4½ per cent. nitrogen in the finished product?

Seven hundred and fifty pounds of tankage, containing 8 per cent. phosphoric acid are being used in a mixture. What per cent. of phosphoric acid will this supply in the finished goods?

Should the Adams' Formula Rule become soiled from handling, it may be readily cleaned with a damp cloth.

PRICE $1.00
TO BE SENT WITH ORDER.
Special quotations on twelve or more.

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Menhaden Meal

New crop is now selling at $52.00 per ton, f.o.b. Baltimore. There are no offerings available on Japanese fish meal at the present time.

Bone Meal

No domestic supplies are being offered at this time. Small quantities of South American 4½ and 50 per cent grade are being offered at $31.00, c.i.f., but there are no quotations beyond July.

BALTIMORE

Decline in Spring Tonnage Smaller Than Expected. New Prices for Materials Now Announced.

Exclusive Correspondence to "The American Fertilizer."

BALTIMORE, July 2, 1940.

The spring shipping season which was just recently brought to a close only ran about 5 per cent under last year's tonnage. Around May 1st it looked as though there would be a much heavier curtailment, but shipments after May 1st ran quite heavy and the season extended into June with the above result. Prices of materials for another season have now about all been announced, with no startling changes.

Ammoniates.—With the heavy consumed period of the year over and products from South America which were formerly shipped to Continental Europe now being available to buyers in this country, the market on feeding materials continues to rule easy. South American tankage is selling at about $2.75 per unit of nitrogen and 10 cents per unit of B.P.L., with ground dried blood being quoted on the same basis.

Nitrogenous Material.—There is practically none of the foreign goods being offered to compete with domestic markets, which range from $2.55 to $2.65 per unit of nitrogen. Buying interest is at a very low ebb, as the demand for fall is for low testing complete fertilizer.

Sulphate of Ammonia.—The new schedule of prices has now been announced on the basis of $28.00 per ton, in bulk, c.a.f. ports, for July/December, and $29.00 per ton for January/June, 1941, for ten equal monthly shipments out of twelve, with an advance of $1.00 per ton where buyers are not in position to take ten equal monthly shipments. There is considerable buying taking place, as most of the manufacturers expected higher prices to prevail.

Nitrate of Soda.—Importers, as well as domestic manufacturers, have announced price of $27.00 per ton, in bulk, over 12 months period up to and including June 30, 1941, but on account of uncertainty of cost of burlap bags, the price in bags is subject to change according to the cost of burlap bags, but for July the price in 100-lb, bags is unchanged at $29.00 per ton and in 200-lb. bags $28.30 per ton, ex store port warehouse.

Fish Scrap.—Fishing up to the present time on the Chesapeake Bay has been light and no further sales have been reported since price of $4.25 per unit of nitrogen and 10 cents per unit of B.P.L., f.o.b. fish factories, was realized, subject to catch and for shipment "if and when made." This price for unground scrap seems out of proportion with other feeding materials and interest is at a minimum, although the market on foreign fish meal continues high, due to present high ocean freight rates.

Superphosphate.—There has been no change in this situation and manufacturers continue to quote run-of-pile at $8.50 per ton of 2,000 lb., basis 16 per cent, and $9.00 per ton for flat 16 per cent, both in bulk, f.o.b. sellers' works, Baltimore.

Manufacturers' Sales Agents for **DOMESTIC**

Sulphate of Ammonia

Ammonia Liquor :: Anhydrous Ammonia

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NATURAL

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Nitrate of Soda

Old Style and Champion
Both Guaranteed
16% NITROGEN

Valuable not only as a source of nitrogen, but also to help maintain the supply of other plant food elements *naturally* blended with it.

Natural Chilean Nitrate of Soda is the only natural nitrate in the world. It's *always reliable.*

CHILEAN NITRATE Sales Corporation

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MONTGOMERY, ALA. COLUMBIA, S. C.
SHREVEPORT, LA. LOS ANGELES, CALIF.

Bone Meal.—The demand continues light, due to high prices which prevail. 3 and 50 per cent domestic steamed bone meal is unchanged at $32.00 to $34.00 per ton, while 4½ and 50 per cent South American raw bone meal ranges from $31.00 to $31.50 per ton, c.i.f. Baltimore.

Potash.—American producers have put in effect prices for muriate for the coming season at 53½ cents per unit K_2O, ex vessel ports, in bulk, subject to usual discount for early orders. Importers are only in position to take business to the extent of stocks in warehouses, but it is figured there will be ample supplies to go around of domestic manufacture and the industry is not overly concerned about supplies for their normal requirements.

Bags.—The market on burlap has been moving up and down, and the present price for plain, new, 10-oz., basis 40 cut 54 in., is about $111.00 per thousand, delivered Baltimore, for fall or spring delivery.

ATLANTA

Manufacturers Covering Requirements on Principal Materials. No Shortage Expected. Imported Cottonseed Meal on Market.

Exclusive Correspondence to "The American Fertilizer."

ATLANTA, July 1, 1940.

The issuance of sulphate of ammonia prices for the ensuing fertilizer year brought about heavy bookings of this commodity from the trade. Prices were only fractionally higher than they were last season. In view of the war situation, the trade felt no hesitancy in covering their estimated requirements.

While no new prices have been issued on nitrate of soda, the July price is unchanged. The price on future months will be issued later.

There does not seem to be any indication of a potash shortage, and organic ammoniates on the whole are attractively priced, and so far in plentiful supply.

South American cottonseed meal and cake is available on this market at prices under the current quoted market here, and quite some tonnage is being booked, especially in the eastern section of the country where the imported material figures cheaper than the domestic, freights considered. The current market is as follows:

Dried Blood.—Imported, $2.50 ($3.04 per unit N), c.i.f.

Fish Tankage.—$2.75 ($3.34½ per unit N) and 10 cents.

SUNSHINE STATE POTASH

A PRODUCT OF NEW MEXICO SERVES THE NATION

The Old Zia Indian sun symbol of New Mexico has been adopted as the trademark of the United States Potash Company. This interesting symbol serves to emphasize the Indian background of New Mexico's history.

SUNSHINE STATE POTASH — A PRODUCT OF NEW MEXICO U.S.A.

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GOOD fertilizer is just as essential to a good crop as rain and sunshine. Plenty of the right fertilizer—containing along with other essential plant foods, the proper potash content—makes for higher yields per acre and better quality.

Every year, thousands of tons of Sunshine State Potash go to enrich the soil in all sections of the country. The year 1940 finds Sunshine State Potash highly regarded by all fertilizer producers. They recognize the consistently uniform analysis of its Muriate of Potash and Manure Salts, and the careful sizing that makes handling and blending easy.

HIGRADE MURIATE OF POTASH

62/63% K_2O

ALSO 50% K_2O GRADE

•

MANURE SALTS

APPROXIMATELY 30% K_2O

UNITED STATES POTASH COMPANY, Incorporated, 30 Rockefeller Plaza, New York, N. Y.

Fish Scrap.—Menhaden, limited quantity dried scrap, $45.00, southern producing points. No acidulated scrap.

Nitrate of Soda.—July same as June.

Sulphate of Ammonia.—July/December, 1940, inclusive, $28.00 port, $27.00 coke oven. January/June, 1941, $29.00 port, $28.00 coke oven. These prices contemplate equal monthly deliveries over a ten months' period, specific months $1.00 per ton higher. Prices this year specify for shipment to buyer's plant, and for their own use and consumption.

Cottonseed Meal.—Prime 8 per cent, $20,00 memphis, fall and winter. On futures board, actual meal here in the southeast for these positions not yet quoted.

Bone Meal.—Steam bone meal, 3 and 50 per cent, $31.00. Raw bone, 4½ and 45 per cent, $31.50, c.i.f. ports.

CHICAGO

Markets Steady at Low Levels. Supply Normal. Feed Material Market Lower.

Exclusive Correspondence to "The American Fertilizer."

CHICAGO, July 1, 1940.

With but little trading, the markets remain fairly steady at the lower price levels. No particular selling urgency is being observed, indicating that shipments on earlier sales prevent excessive accumulation.

Continued decline in digester tankage and meat scraps, list price of which is now $37.50 per ton, resulted in lower markets for materials.

Nominal prices are as follows: high-grade ground fertilizer tankage, $1.95 to $2.00 ($2.37 to $2.43 per unit N) and 10 cents; standard grades crushed feeding tankage, $1.90 to $2.00 ($2.31 to $2.43 per unit N) and 10 cents; blood, $2.05 to $2.10 ($2.49 to $2.55½ per unit N); dry rendered tankage, 42 to 52 cents per unit, Chicago basis.

WILMINGTON

Organics Market Weak. Fishing Very Poor and Producers Behind on Orders. Tobacco Acreage Uncertain.

Exclusive Correspondence to "The American Fertilizer."

WILMINGTON, July 1, 1940.

There has been extremely little activity in organics during the past two weeks. Weak markets, the uncertainty of the war situation and heavy carry over appear to have stilled any interest that might have appeared.

The fishing along the Atlantic Coast has been the poorest in years and producers are still behind in filling their early contracts. Most of them are trying yet to fill orders that should have moved in May. The prices are nominal as there is no actual tonnage being offered.

Superphosphate was quoted by one large manufacturer at 47½ cents per unit, run-of-pile, Wilmington, N. C., but many mixers are holding off to await developments in the crop situation and the prospects for acreages to be allowed tobacco planters next season.

PHILADELPHIA

Sulphate of Ammonia and Superphosphate Orders Being Placed. Market Generally Inactive.

Exclusive Correspondence to "The American Fertilizer."

PHILADELPHIA, July 3, 1940.

The inactivity of the fertilizer materials market continues. Nitrate of soda deliveries during the past week continued fair. No interest was shown in other materials regardless of price concessions.

Nitrate of Soda.—Price continues during July but nothing definite regarding the balance of the season.

Sulphate of Ammonia.—Upon the issuance

PULVERIZED MASCOT LIMESTONE
Trade Mark Registered

MAGNESIUM LIMESTONE
"It's a Dolomite"
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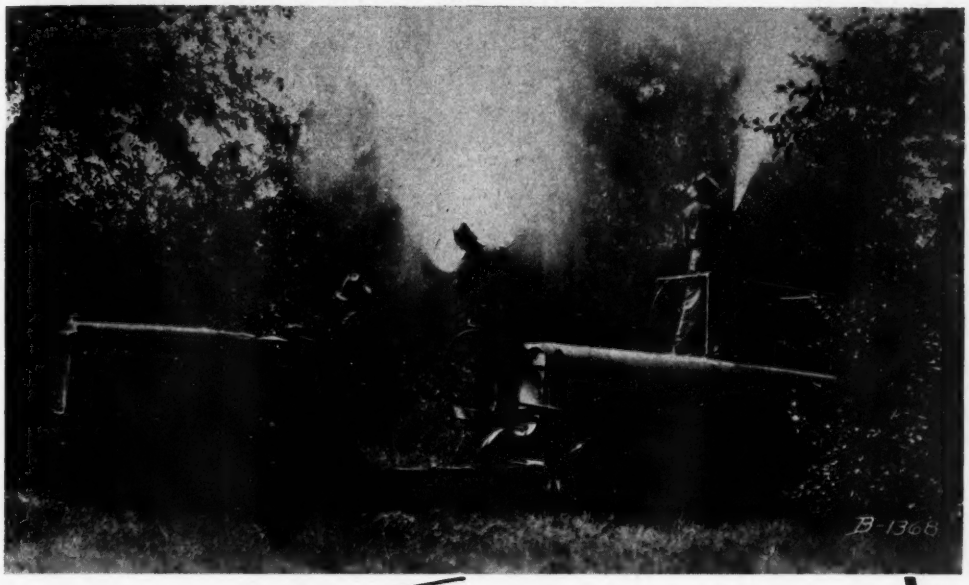

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of the new prices, a fair portion of contracts for the coming season has been placed.

Dried Blood.—Not interesting to buyers. Offerings at $2.25 ($2.73½ per unit N) arouses no attention.

Tankage.—Little Demand. Nominal price about $2.25 ($2.73½ per unit N) and 10 cents.

Bone Meal.—Prices remain firm. 1 and 65 per cent at about $35.00; 3 and 50 per cent at $33.00; 4½ and 45 per cent about $35.00.

Superphosphate.—Some orders being placed for the coming year. Price firm.

Potash.—Published schedules prevail.

TENNESSEE PHOSPHATE

Shipments Slacken But Plants Operate to Capacity. Scientists Hold Meeting in Phosphate Section.

Exclusive Correspondence to "The American Fertilizer."

COLUMBIA, TENN., July 1, 1940.

The customary June lull in shipments of phosphate rock has been in evidence most of this month in practically all lines of consumption and not very much movement can be anticipated in July until toward the middle or latter part of the month. Weather conditions are ideal and all the plants, having been put in apple-pie order, are in rather full operation, laying in stocks of finished material in readiness for the active season.

There have been several press references to recent unearthing of portions of a mastodon skeleton imbedded in the phosphate deposit in the Estes Bend section, northwest of Columbia, with consequent talk of this indicating a much more recent date of deposition of these phosphate deposits than the fully determined Ordovician age when the only form of life was molluscan.

This is the third such discovery, the first in Jonesboro at Mt. Pleasant in the last years of the 19th century and the second in the Satterfield region west of Kleburne and Spring Hill. Careful investigation in all three cases would reveal that the mastodon fell into some crevasse from the surface probably millions of years after the phosphate deposit was in place, and subsequent caving in of the sides left the skeleton apparently in place in the deposit of phosphate.

Mt. Pleasant and Columbia have had three visits within the past ten days from three different groups of people interested in the phosphate deposits and operations, from widely scattered sections of the United States.

On June 21st, a party of about 150 of the farmers and agricultural experimental workers interested in the experimental and demonstrational work with the Land Grant Colleges of 24 states, under the auspices of the TVA and University of Tennessee, visited the Middle Tennessee Experiment Station and the phosphate mines and washer plant of the Hoover & Mason Phosphate Co., on their way to the Furnace plants of the TVA at Muscle Shoals.

On the same day the southeast section of the American Institute of Mining and Metallurgical Engineers visited the plant of the Monsanto Chemical Co. near Columbia and held their dinner meeting that night at Nashville, where papers were presented on the geology, mining and milling of phosphate. On Saturday, June 22nd, about one hundred visited the mines of the Hoover & Mason Phosphate Co., the washer and flotation plant of the International Agricultural Corporation and the Phosphate Recovery Co., and the washing, drying, flotation and modulizing plant of the Charleston Mining Co. Later the entire party enjoyed a fish fry at Arrow Lake near Mt. Pleasant.

On June 28th, the convention of District and State Representatives of the Ruhm Phosphate & Chemical Co. met at Mt. Pleasant. About 70 of the representatives and their

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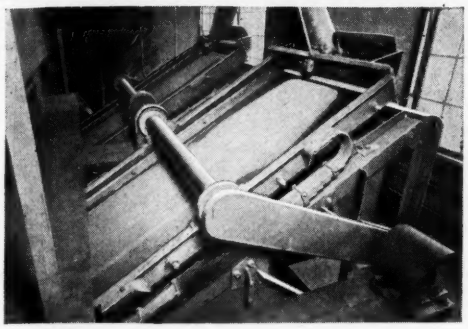

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Information and references available on request.

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Pioneer Producers of Muriate of Potash in America
See Page 4

ladies with the local forces of Hoover & Mason and the Ruhm Companies had lunch at the Maury Hotel, followed by trips to points of interest for the ladies and afternoon and evening meetings for men.

On June 29th, some of the party were shown through the Monsanto Plant and the entire party inspected the mines and plant of the Hoover & Mason Co., where Ruhm's phosphate for direct application is prepared for shipment to farmers in 27 states and Canada. and wound up with a fish fry and afternoon meting at Hoover Scout Lodge.

All three meetings secured considerable information on phosphate rock, both as a raw material and as a finished product.

NEW FLEXIBLE COUPLING CATALOG ANNOUNCED BY LINK-BELT

A new 12-page illustrated Catalog No. 1845 has been published by Link-Belt Company, 307 North Michigan Avenue, Chicago, on the company's complete line of flexible couplings.

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A copy of the book will be sent to any interested reader upon request.

POSSIBLE DEVELOPMENT OF THE SUPERPHOSPHATE INDUSTRY

(Continued from page 7)

hydrolysis of the monocalcium phosphate to insoluble products occurs. The result is that the water-soluble compounds of the superphosphate have little or no direct fertilizing effect. This, of itself, would not constitute a disadvantage, if the phosphoric acid in these compounds were easily assimilated by the plant roots, because in such circumstances the superphosphate would possess the advantage, as contrasted with other water-insoluble phosphatic fertilizers, that its phosphoric acid would be more evenly distributed in the soil.

Unfortunately, in practice the foregoing is not realized. The new products formed with iron and alumina are at first citrate-soluble, but after a time, and especially after periods of drought, they lose their citrate-solubility, and consequently their fertilizing value is reduced. This loss of solubility occasionally takes place so rapidly that a soil known, by analysis, to require phosphoric acid, has revealed no increase of yield when fertilized with a normal quantity of superphosphate. The fixation and transformation into insoluble compounds is more intensive in acid soils, because iron and alumina are present in a more reactive form than in alkaline soils. Even in neutral or alkaline soils, having little, if indeed, any iron, the fixation of the water-soluble phosphoric acid occurs fairly rapidly, although slower than in acid soils. This probably depends on hydrolysis, and on the formation of dicalcium phosphate and hydroxylapatite, which latter compound is insoluble to plants.

That the phosphoric acid content of superphosphate is constantly fixed in all soils, is shown by the fact that the quantity of phosphoric acid absorbed by plants during the first year seldom exceeds 40 to 50 per cent of the total quantity used, and may even be as low as 15 to 25 per cent.[8] In acid soils it is often lower than the latter figure. Obviously, a modern fertilizer should be more efficient than this.

Effectiveness Improved by Granulation

That the superphosphate industry must consider methods by which to reduce, or otherwise avoid, the fixation referred to, clearly connoting insolubility of the phosphoric acid, is manifest. Equally, an effort must be made to increase the fertilizing effect of the superphosphate. Two methods of approaching this problem are available to the manufacturer. The first is to render the physical properties of the superphosphate such that the fixation of the water-soluble phosphoric acid is reduced, or obviated. The other is to modify the chemical composition of the

[8] See among others: K. Iversen, Tidskrift for Planteavl, Copenhagen, *43*, No. 3 (1938); S. F. Thornton, Purdue University, Agr. Experiment Station, Lafayette, Indiana, U. S. A., Bull. 399, ref. in Superphosphate, *12*, 120 (1939).

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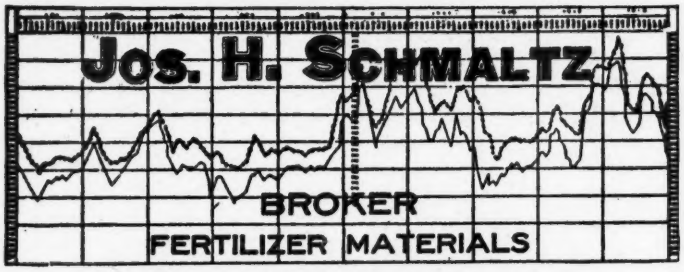

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CHARLOTTE, N. C.

product, so that the reactions by which the insoluble compounds are formed cannot occur.

The first of these methods has already been exploited in a practical manner by the granulation of the product, although the results of such granulation are not yet fully realized.[9] The United States have taken the lead in this development. The American Oberphos process, where decomposition is effected in an autoclave, produces a superphosphate in a more or less granular form.[10] Superphosphate produced in dens in the usual way may also be granulated. The manufacture of granulated superphosphate from the ordinary product was begun some years ago by The Davison Chemical Corporation, Baltimore.[11] Their product is being sold in increasing quantities. In Europe only compound fertilizers have been sold in granulated form, but during the last year the question of granulation has been investigated by several workers, as indeed by the authors.

The interest which granulated superphosphate has evoked up to now is mainly attributable to the essential advantages arising from its storage, transport and use. The granulated product is less susceptible to "caking," when stored, than ordinary superphosphate. It can be loaded into bags of different types, such as, for example, paper valve bags. The bags are subjected to considerably less attack by the granulated product than by pulverized superphosphate, and consequently the bags can be stored over a longer period. Moreover, losses due to dust are avoided.

An advantage to the farmers arises from the fact that the granulated product will not "film" the distributing machinery, which not infrequently happens with ordinary superphosphate. Another merit, which hitherto has not been adequately appreciated, is that granulated superphosphate can be introduced into the soil at exactly the right depth[12]—a feature of the greatest importance in the problem of effective fertilization. This effect may be still further increased if the superphosphate is distributed in drills between the rows of seeds. The yields thus obtained are considerably greater than if the superphosphate were uniformly distributed in the soil.[13] If granulated superphosphate is placed in rows at the right depth, the increase of yield is surprising. Field tests made by O. Franck with granulated superphosphate, placed in rows at a distance of 11 cm. on both sides of the seeds and at a depth of 8 to 10 cm. in certain Swedish soils having a high degree of fixation for phosphoric acid, have given an increased yield of oats of 500 kilos per hectare, compared with trials in which the same amount of finely-ground superphosphate was introduced to the soil in the ordinary way.[14] It is reasonable to assume that this means of improving the fertilizing effect will result in an increased demand for granulated superphosphate.

This improvement in the fertilizing effect of granulated superphosphate over ordinary superphosphate is due to a lesser fixation of water-soluble phosphoric acid. Thus, more of the latter is available for use by the plant or root crops. The improvement in question is the more marked, the more uniform the distribution, a condition that can be attained when granulated superphosphate is applied in drills. This increased fertilizing effect, which is particularly evident on acid soils containing iron and alumina, has recently (in 1937) been ascertained by the investigations made by O. Franck, at the Central Institute for Agricultural Research at Stockholm.[15] His results have been confirmed by tests undertaken by G. Torstensson, of the Academy of Agriculture at Ultuna, Sweden,[16] which were published about the same time, and by other later field tests.

[9] Wm. H. Ross, J. Ass. Off. Agr. Chem., *15*, 632-635 (1932).

[10] See U. S. A. pat. 1,947,138, 1,982,479, Re 19825; French pat. 726,716, German pat. 56422 and others; also American Fertilizer, *82*, 5 (1935).

[11] U. S. A. pat. 2,136,793, Brit. pat. 491,841, French pat. 822,891, and others.

[12] O. Franck, loc. cit.; G. Torstensson, loc. cit.; O. Franck, Kgl. Lantbruksakademiens Tidskrift, Stockholm, *78*, 113-124 (1939), with German summary.

[13] Superphosphate, *7*, 30-35 (1934); Bureau of Chemistry and Soils; The Fertilizer Review, Washington, *9*, 14 (1934); H. R. Smalley. American Fertilizer, *82*, 7 (1935); U. S. Blair, Scientific Agriculture, Ottawa, *17*, 279 (1937).

[14] O. Franck, Kgl. Lantbruksakademiens Tidskrift, Stockholm, loc. cit.

[15] O. Franck, Meddelande nr. 483 fran Centralanstalten för försöksväsendet pa jordbruksomradet, Stockholm, 1937, with an English summary.

[16] G. Torstensson, loc. cit.

(To be concluded in next issue)

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CHEMICAL PLANT CONSTRUCTION
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Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CHEMISTS AND ASSAYERS
Gascoyne & Co., Baltimore, Md.
Stillwell & Gladding, New York City.
Wiley & Company, Baltimore, Md.

CLUTCHES
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

CONCENTRATORS—Sulphuric Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

CONDITIONERS AND FILLERS
American Limestone Co., Knoxville, Tenn.

CONTACT ACID PLANTS
Chemical Construction Corp., New York City.

COPPER SULPHATE
Tennessee Corporation, Atlanta, Ga.

COTTONSEED PRODUCTS
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

CRANES AND DERRICKS
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

CYANAMID
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

DENS—Superphosphate
Chemical Construction Corp., New York City.
Stedman's Foundry and Mach. Works, Aurora, Ind.

Andrew M. Fairlie
CHEMICAL ENGINEER
22 Marietta Street Building ATLANTA, GA.
CABLE ADDRESS: "SULFACID ATLANTA"

SULPHURIC Acid Plants . . . Design, Construction, Equipment . . . Operation . . . Mills-Packard Water-Cooled Acid Chambers, Gaillard Acid-Cooled Chambers, Gaillard Acid Dispersers, Contact Process Sulphuric Acid Plants.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

DISINTEGRATORS
Atlanta Utility Works, East Point, Ga.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DOUBLE SUPERPHOSPHATE (See Superphosphate—Concentrated)

DRYERS—Direct Heat
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Sackett & Sons Co., The A. J., Baltimore, Md.

DRIVES—Electric
Link-Belt Company, Philadelphia, Chicago.

DUMP CARS
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

DUST COLLECTING SYSTEMS
Sackett & Sons Co., The A. J., Baltimore, Md.

ELECTRIC MOTORS AND APPLIANCES
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

ELEVATORS
Atlanta Utility Works, East Point, Ga.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ELEVATORS AND CONVEYORS—Portable
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

ENGINEERS—Chemical and Industrial
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

ENGINES—Steam
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

EXCAVATORS AND DREDGES—Drag Line and Cableway
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.

FERTILIZER MANUFACTURERS
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Farmers Fertilizer Co., Columbus, Ohio.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
U. S. Phosphoric Products Corp., New York City.

FISH SCRAP AND OIL
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

FOUNDERS AND MACHINISTS
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GARBAGE TANKAGE
Wellmann, William E., Baltimore, Md.

GEARS—Machine Moulded and Cut
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

GEARS—Silent
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

GELATINE AND GLUE
American Agricultural Chemical Co., New York City.

GUANO
Baker & Bro., H. J., New York City.

HOISTS—Electric, Floor and Cage Operated, Portable
Hayward Company, The, New York City.
Jeffrey Manufacturing Co., The, Columbus, Ohio.

HOPPERS
Atlanta Utility Works, East Point, Ga.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

IMPORTERS, EXPORTERS
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

IRON SULPHATE
Tennessee Corporation, Atlanta, Ga.

INSECTICIDES
American Agricultural Chemical Co., New York City.

LACING—Belt
Sackett & Sons Co., The A. J., Baltimore, Md.

LIMESTONE
American Agricultural Chemical Co., New York City.
American Limestone Co., Knoxville, Tenn.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Wellmann, William E., Baltimore, Md.

LOADERS—Car and Wagon, for Fertilizers
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Acid Making
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Monarch Mfg. Works, Inc., Philadelphia, Pa.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Coal and Ash Handling
Hayward Company, The, New York City.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

MACHINERY—Elevating and Conveying
Atlanta Utility Works, East Point, Ga.
Hayward Company, The, New York City.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

MACHINERY—Grinding and Pulverizing
Atlanta Utility Works, East Point, Ga.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Power Transmission
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MACHINERY—Pumping
Atlanta Utility Works, East Point, Ga.

MACHINERY—Tankage and Fish Scrap
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MAGNESIA
California Chemical Co., New York City.

MAGNETS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

MANGANESE SULPHATE AND CARBONATE
Tennessee Corporation, Atlanta, Ga.

MANGANESE SULPHATE
Tennessee Corportion, Atlanta, Ga.

MIXERS
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

NITRATE OF SODA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Chilean Nitrate Sales Corp., New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

NITRATE OVENS AND APPARATUS
Chemical Construction Corp., New York City.

NITROGENOUS ORGANIC MATERIAL
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Smith-Rowland Co., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

NOZZLES—Spray
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PACKING—For Acid Towers
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Chemical Construction Corp., New York City.

PANS AND POTS
Stedman's Foundry and Mach. Works, Aurora, Ind.

PHOSPHATE MINING PLANTS
Chemical Construction Corp., New York City.

PHOSPHATE ROCK
American Agricultural Chemical Co., New York City.
American Cyanamid Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Charleston Mining Co., Inc., Richmond, Va.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Ruhm, H. D., Mount Pleasant, Tenn.
Schmaltz, Jos. H., Chicago, Ill.
Southern Phosphate Corp., Baltimore, Md.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

PIPES—Chemical Stoneware
Chemical Construction Corp., New York City.

PIPES—Wooden
Stedman's Foundry and Mach. Works, Aurora, Ind.

PLANT CONSTRUCTION—Fertilizer and Acid
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.

POTASH SALTS—Dealers and Brokers
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Synthetic Nitrogen Products Co., New York City.
Taylor, Henry L., Wilmington, Del.
Wellmann, William E., Baltimore, Md.

POTASH SALTS—Manufacturers and Importers
American Potash and Chem. Corp., New York City.
Potash Co. of America, Baltimore, Md.
United States Potash Co., New York City.

PULLEYS AND HANGERS
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

PUMPS—Acid-Resisting
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

PYRITES—Brokers
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Jett, Joseph C., Norfolk, Va.
Wellmann, William E., Baltimore, Md.

QUARTZ
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

RINGS—Sulphuric Acid Tower
Chemical Construction Corp., New York City.

A Classified Index to Advertisers in "The American Fertilizer"

BUYERS' GUIDE

For an Alphabetical List of all the Advertisers, see page 33

ROUGH AMMONIATES
Bradley & Baker, New York City.
Schmaltz, Jos. H., Chicago, Ill.
Wellmann, William E., Baltimore, Md.

SCALES—Including Automatic Bagging
Atlanta Utility Works, East Point, Ga.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SCRAPERS—Drag
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Hayward Company, The, New York City.
Link-Belt Company, Philadelphia, Chicago.

SCREENS
Atlanta Utility Works, East Point, Ga.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SEPARATORS—Air
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Including Vibrating
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

SEPARATORS—Magnetic
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHAFTING
Atlanta Utility Works, East Point, Ga.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.
Stedman's Foundry and Mach. Works, Aurora, Ind.

SHOVELS—Power
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Link-Belt Speeder Corp., Chicago, Ill. and Cedar Rapids, Iowa.
Sackett & Sons Co., The A. J., Baltimore, Md.

SPRAYS—Acid Chambers
Monarch Mfg. Works, Inc., Philadelphia, Pa.

SPROCKET WHEELS (See Chains and Sprockets)

STACKS
Sackett & Sons Co., The A. J., Baltimore, Md.

SULPHATE OF AMMONIA
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Barrett Company, The, New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
Hydrocarbon Products Co., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Snythetic Nitrogen Products Co., New York City.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

SULPHUR
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Freeport Sulphur Co., New York City.
Texas Gulf Sulphur Co., New York City.

SULPHURIC ACID
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.

SULPHURIC ACID—Continued
Bradley & Baker, New York City.
Huber & Company, New York City.
Jett, Joseph C., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
U. S. Phosphoric Products Corp., New York City.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
Huber & Company, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Taylor, Henry L., Wilmington, N. C.
U. S. Phosphoric Products Corp., New York City.
Wellmann, William E., Baltimore, Md.

SUPERPHOSPHATE—Concentrated
Armour Fertilizer Works, Atlanta, Ga.
International Agricultural Corp., New York City.
U. S. Phosphoric Products Corp., New York City.

SYPHONS—For Acid
Monarch Mfg. Works, Inc., Philadelphia, Pa.

TALLOW AND GREASE
American Agricultural Chemical Co., New York City.

TANKAGE
American Agricultural Chemical Co., New York City.
Armour Fertilizer Works, Atlanta, Ga.
Ashcraft-Wilkinson Co., Atlanta, Ga.
Baker & Bro., H. J., New York City.
Bradley & Baker, New York City.
International Agricultural Corp., New York City.
Jett, Joseph C., Norfolk, Va.
Schmaltz, Jos. H., Chicago, Ill.
Smith-Rowland Co., Norfolk, Va.
Taylor, Henry L., Wilmington, N. C.
Wellmann, William E., Baltimore, Md.

TANKAGE—Garbage
Huber & Company, New York City.

TANKS
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Sackett & Sons Co., The A. J., Baltimore, Md.

TILE—Acid-Proof
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.

TOWERS—Acid and Absorption
Chemical Construction Corp., New York City.
Fairlie, Andrew M., Atlanta, Ga.

UNLOADERS—Car and Boat
Hayward Company, The, New York City.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Link-Belt Company, Philadelphia, Chicago.
Sackett & Sons Co., The A. J., Baltimore, Md.

UREA
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Snythetic Nitrogen Products Co., New York City.

UREA-AMMONIA LIQUOR
Du Pont de Nemours & Co., E. I., Wilmington, Del.

VALVES—Acid-Resisting
Atlanta Utility Works, East Point, Ga.
Charlotte Chem. Laboratories, Inc., Charlotte, N. C.
Jeffrey Manufacturing Co., The, Columbus, Ohio.
Monarch Mfg. Works, Inc., Philadelphia, Pa.

WHEELBARROWS (See Carts)

ZINC SULPHATE
Tennessee Corporation, Atlanta, Ga.

ALPHABETICAL LIST OF ADVERTISERS

For Classified Index, see pages 28 to 32, inclusive

American Agricultural Chemical Co., New York City 3
American Cyanamid Co., New York City..—
American Limestone Co., Knoxville, Tenn. 20
American Potash and Chemical Corp., New York City 4, 23
Armour Fertilizer Works, Atlanta, Ga.....—
Ashcraft-Wilkinson Co., Atlanta, Ga. 4
Atlanta Utility Works, East Point, Ga.....—

Bagpak, Inc., New York City .....—
Baker & Bro., H. J., New York City, Front cover, 22
Barrett Company, The, New York City, Back cover
Bemis Bro., Bag Company, St. Louis, Mo..—
Bradley & Baker, New York City.....14

Charleston Mining Co., Inc., Richmond, Va.—
Charlotte Chemical Lab., Charlotte, N. C. ..25
Chemical Construction Corp., New York City .....—
Chilean Nitrate Sales Corp., New York City.18

Dougherty, Jr., E., Philadelphia, Pa.....33
DuPont de Nemours & Co., E. I., Wilmington, Del. .....—
Duriron Company, Dayton, Ohio.....—

Fairlie, Andrew M., Atlanta, Ga.....29
Farmers Fertilizer Co., Columbus, Ohio...34

Gascoyne & Co., Inc., Baltimore, Md.....34

Hayward Company, The, New York City..34
Huber Company, L. W., New York City..—
Hydrocarbon Products Co., New York City.17

International Agricultural Corporation, New York City .....2d cover

Jeffrey Manufacturing Co., The, Columbus, Ohio 26
Jett, Joseph C., Norfolk, Va. 34

Keim, Samuel D., Philadelphia, Pa.....33

Link-Belt Company, Chicago, Ill. 23

Monarch Mfg. Works, Inc., Philadelphia, Pa. 34

Pacific Coast Borax Co., New York City, 2d cover
Polk Co., R. L., Detroit, Mich. .....—
Potash Co. of America, Baltimore, Md., 3d cover

Ruhm, H. D., Columbia, Tenn. 34

Sackett & Sons Co., The A. J., Baltimore, Md. .....—
Schmaltz, Jos. H., Chicago, Ill. 25
Smith-Rowland Co., Norfolk, Va.....—
Southern Phosphate Corp., Baltimore, Md. 25
Stedman's Foundry and Machine Works, Aurora, Ind. 24
Stillwell & Gladding, New York City.....34
Synthetic Nitrogen Products Co., New York City .....—

Taylor, Henry L., Wilmington, N. C.....28
Tennessee Corporation, Atlanta, Ga. .....—
Texas Gulf Sulphur Co., New York City..21

U. S. Phosphoric Products Corp., New York City 23
United States Potash Co., New York City..19

Wellmann, William E., Baltimore, Md.....25
Wiley & Company, Inc., Baltimore, Md. 34

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By-Products *and* Fertilizer Materials

(SINCE 1898)

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See Catalog 6-C

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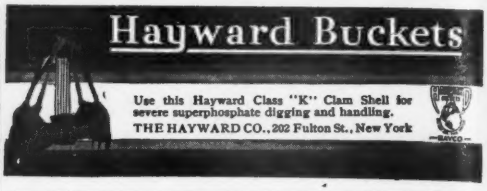
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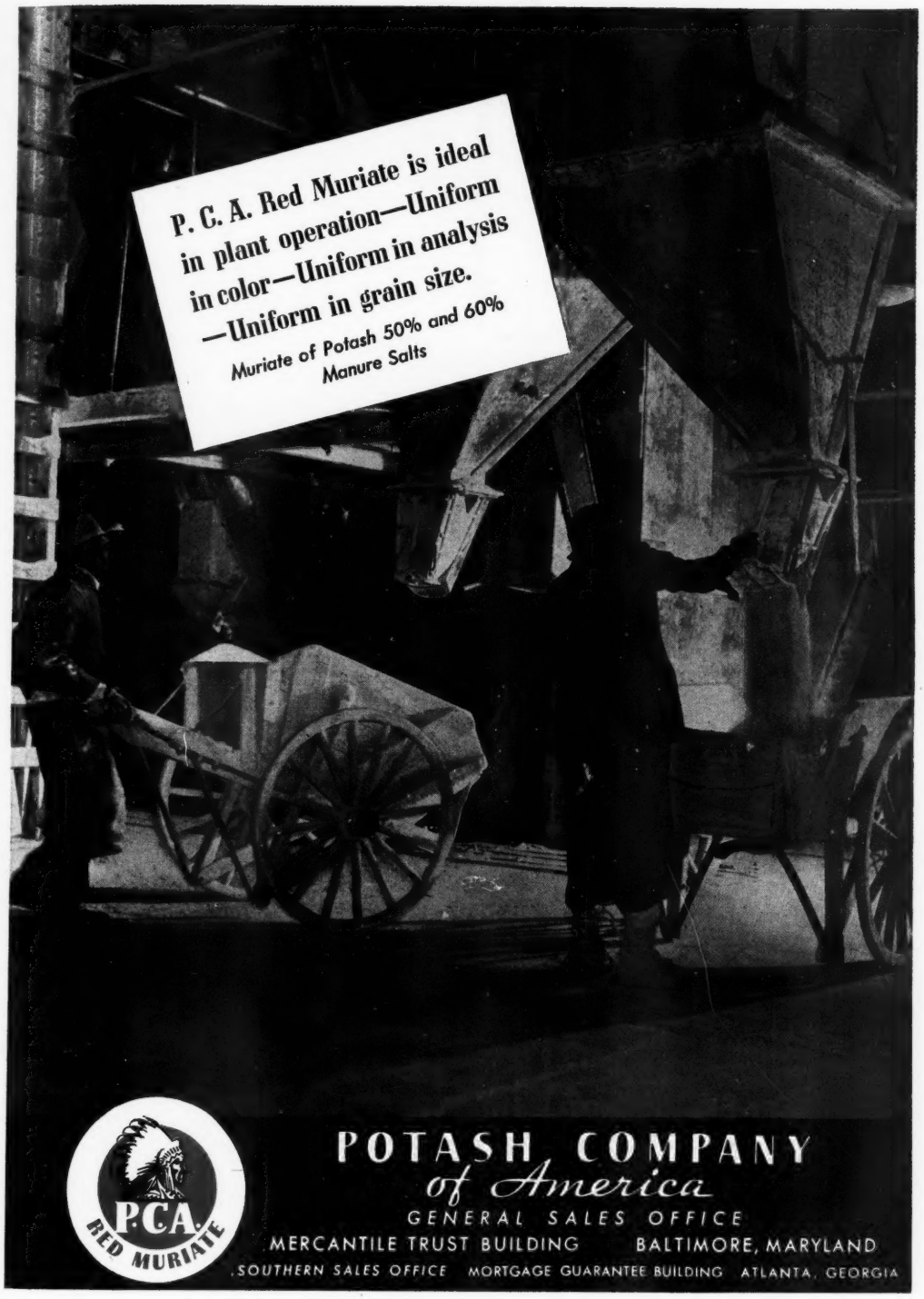

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SULPHATE OF AMMONIA

ARCADIAN
THE AMERICAN
NITRATE OF SODA

Barrett
STANDARD ANHYDROUS AMMONIA
AMMONIA LIQUOR

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